Title

Who Poisoned Buzz Lightyear?

Introduction

Buzz Lightyear was poisoned. 20 people came to his cooking show with 4 different materials- a drink, a wrap, a powder, and a hot dog. The students know who came and what they brought. To find out who poisoned him, the students are going to be conducting many tests on the different materials that the suspects had. Then they will compare that data to the data collected from conducting the same tests on the evidence at the crime scene to determine what was left at the crime scene. Then they will determine who did it by comparing the materials left at the crime scene to the materials brought by the suspects.

Hypothesis

If salt water, aluminum, sodium chloride, and a fat free hot dog were left at the crime scene, then Darth Vader poisoned Buzz, because he was the one with those materials.

Materials

General materials

* Well plate
* Glass beakers
* Eyedroppers
* Sodium bicarbonate (baking soda)
* Conductivity meter
* Triple beam balance
* Plastic graduated cylinder
* Hydrochloric acid
* Goggles
* Forceps
* Hand lens
* Hot plates
* Iodine
* Paper cups
* Stirring rods
* Spoons
* Matches

Drinks

* Pure water
* Alcohol
* Salt water
* Vinegar
* Grape drink
* Lemonade

Wraps

* Plastic
* Aluminum
* Zinc
* Copper
* Iron
* Sulfur

Powders

* Sucrose (sugar)
* Sodium bicarbonate(baking soda)
* Sodium polyacrylate
* Sodium chloride (table salt)
* Ascorbic acid

Hot Dogs

* Pork hot dog
* Light pork hot dog
* Fat free hot dog

Procedures

Drinks

Conductivity

1. Fill one of the holes in the well plate with one of the liquid.
2. Put the tips of the conductivity meter in the liquid.
3. Observe how bright the lights are and compare it to the back of the meter.

Density

1. Pour about 10ml of water in a graduated cylinder.
2. Pour another 10ml of the liquid you are testing in.
3. Observe whether the liquid sinks or floats in the water.

Reactivity with baking soda

1. Fill one of the holes in the well plate with one of the liquid.
2. Pour ¼ a spoonful of baking soda into each liquid.
3. Observe what happens.

Flammability

1. Pour 100ml of the liquid in a beaker.
2. Light a match and place it in the liquid.
3. Observe whether or not it burns.

Wraps

Conductivity

1. Touch the tips of the meter to the wrap.
2. Observe how bright the lights are and compare it to the back of the meter.

Density

1. Place the piece of metal on a triple beam balance and move the weights right until the end of the beams is aligned with the mark. Look at where the weights are to determine the mass.
2. Fill a graduated cylinder with 50ml of water. Drop the wrap in the water and observe how much the water level rises. The amount that the water level rises is volume.
3. Divide mass/volume

Reactivity with hydrochloric acid

1. Place one piece of the metal in the well plate.
2. Put two drops of the hydrochloric acid on the metal and observe what happens.

Powders

Solubility

1. Fill one of the two deeper holes in the well plate with water.
2. Place a very small amount of the powder in the water.
3. Stir it with the stirring rod. Observe whether or not the powder dissolves.

Melting

1. Observed whether or not the powders melted on the burner.

Conductivity

1. Fill one of the two deeper holes in the well plate with water.
2. Place a very small amount of the powder in the water.
3. Stir it with the stirring rod.
4. Place the tips of the conductivity meter in the solution and observe how bright the lights are and compare it to the back of the meter.

Reactivity with vinegar

1. Fill one of the holes on the well plate with the substance.
2. Pour 2 drops of vinegar on. Observe what happens.

Flammability

1. Light a match and put it on the powders. Observe whether or not it burns.

Hot dogs

Mass (pre-squeeze)

1. Place the hot dog on a triple beam balance.
2. Move the weights right until the beam is aligned with the mark. Record what number each weight is on to determine the mass.

Mass (post-squeeze)

1. Place the hot dog parts on a triple beam balance.
2. Move the weights right until the beam is aligned with the mark. Record what number each weight is on to determine the mass.

Density (pre-squeeze)

1. Fill a 100ml graduated cylinder with 60ml of water.
2. Drop the hot dog in and record how much the water rises.
3. Divide mass/volume

Conductivity (pre-squeeze or post-squeeze)

1. Place the tips of the conductivity meter in the hot dog. Observe how bright the lights are and compare it to the back of the meter.

Reactivity with iodine (pre squeeze)

1. Get a beaker with iodine and an eyedropper in it.
2. Put two drops of iodine on the hot dog (not on the skin). Observe what happens.

Data

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| --- | --- | --- | --- | --- | --- | --- |
| Drink | Physical: color | Physical: conductivity | Physical: density | Physical: optical properties | Chemical: flammability | Chemical: reactivity with baking soda (NaHCO3) |
| Pure water | Clear | Low | 1 g/ml | Transparent | No | None |
| Alcohol | Clear | None | >water | Transparent | Yes | None |
| Salt water | Clear; slightly cloudy | Very high | >water | Transparent | No | None |
| Vinegar | Clear | medium | >water | Transparent | No | Lot of fizz |
| Grape drink | Purple | Medium | >salt water | Opaque | No | Fizzed with bubbles |
| Lemonade | Yellow; cloudy | Low | >water | Translucent | No | Little fizz |
| Crime scene liquid | clear | low | 1 g/ml | Transparent | No | None |

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| --- | --- | --- | --- | --- |
| Drink | Observations | Pure substance or mixture? | If it is a mixture: Homogenous or heterogeneous? | If it is a pure substance: element or compound? |
| Pure water | Clear | Pure substance |  | Compound |
| Alcohol | Clear | Pure substance |  | Compound |
| Salt water | Clear; slightly cloudy | Mixture | Homogenous |  |
| Vinegar | Clear | Mixture | Homogenous |  |
| Grape drink | Purple | Mixture | Homogenous |  |
| Lemonade | Yellow; slightly cloudy | Mixture | Homogenous |  |
| Crime scene liquid | clear | Pure substance |  | Compound |

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| --- | --- | --- | --- | --- | --- |
| Wrap | Physical: malleability | Physical: luster | Physical: conductivity | Physical: density | Chemical: reactivity with hydrochloric acid (HCl) |
| Plastic | Yes | Glossy | None | 1g/ml | None |
| Aluminum | Yes | Shiny | Very high | 1g/ml | None |
| Zinc | Yes | Shiny | Very high | 2g/ml | Few bubbles |
| Copper | Yes | Shiny | Very high | 3g/ml | Cleaned? |
| Iron | Yes | Shiny | Very high | 2g/ml | Many bubbles |
| Sulfur | No | Glossy | None | 2.5g/ml | None |
| Crime scene wrap | yes | Shiny | Very high | 2g/ml | Many bubbles |

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| --- | --- | --- | --- | --- |
| Wrap | Observations | Pure substance or mixture? | If it is a mixture: Homogenous or heterogeneous? | If it is a pure substance: element or compound? |
| Plastic | Clear purple | Pure substance |  | Compound |
| Aluminum | Silver | Pure substance |  | Element |
| Zinc | Silver | Pure substance |  | Element |
| Copper | Brown | Pure substance |  | Element |
| Iron | Silver | Pure substance |  | Element |
| Sulfur | Yellow pieces | Pure substance |  | Element |
| Crime scene wrap | Silver | Pure substance |  | Element |

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| --- | --- | --- | --- | --- | --- |
| Powders | Physical: solubility | Physical: melting | Physical: conductivity | Chemical: flammability | Chemical: reactivity with vinegar |
| Sucrose (C6H12O6) | Yes | Yes | Very high | No | None |
| Baking soda (NaHCO3) | Yes | No | Very high | No, but burnt | Bubbles |
| Sodium polyacrylate | No | No | High | No | Gel was created |
| Sodium chloride (NaCl) | Yes | No | Very high | No | None |
| Ascorbic acid (C6H8O6) | Yes | Yes | High | No | None |
| Crime scene powder | Yes | Yes | Very high | No | None |

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| --- | --- | --- | --- | --- |
| Powder | Observations | Pure substance or mixture? | If it is a mixture: Homogenous or heterogeneous? | If it is a pure substance: element or compound? |
| Sucrose (C6H12O6) | Somewhat clear, white grains | Pure substance |  | Compound |
| Baking soda (NaHCO3) | White powder | Pure substance |  | Compound |
| Sodium polyacrylate | White powder | Pure substance |  | Compound |
| Sodium chloride (NaCl) | White powder | Pure substance |  | Compound |
| Ascorbic acid (C6H8O6) | Yellow powder with some chunks | Pure substance |  | Compound |
| Crime scene powder | White powder | Pure substance |  | Compound |

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| --- | --- | --- | --- | --- | --- |
| Hot dog | Physical: density | Physical: conductivity | Physical: mass pre-squeeze | Physical: mass post squeeze | Chemical: reactivity with iodine |
| Pork | 1.032g/ml | Medium | 10g | 8.9g (-1.1g) | Black/dark purple color |
| Light | 1.07g/ml | Very high | 10.7g | 9.8g (-0.9g) | Slightly yellow |
| Fat free | 1.13g/ml | High | 10.2g | 8.7g (-1.5g) | Brown/black |
| Crime scene hot dog | 1.009g/ml | High | 11.1g | 10.1g (-1.0g) | Black/dark purple/brown |

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| --- | --- | --- | --- | --- |
| Hot dog | Observations | Pure substance or mixture? | If it is a mixture: Homogenous or heterogeneous? | If it is a pure substance: element or compound? |
| Pork | Darkest colored hot dog | Mixture | Homogenous |  |
| Light | Lighter colored hot dog | Mixture | Homogenous |  |
| Fat free | Lightest colored hot dog | Mixture | Homogenous |  |
| Crime scene hot dog | Darker pink color | Mixture | Homogenous |  |

Conclusion

The student’s hypothesis was wrong. He thought that salt water, aluminum, sodium chloride, and a fat free hot dog was what were left at the crime scene, so Darth Vader did it. The data shows that pure water, iron, sucrose, and a pork hot dog was what was left at the crime scene, which means Ariel poisoned Buzz since she had brought the materials that were . The data matches for pure water, iron, and sucrose match exactly with the crime scene materials, however, the hot dog data does not match as well. The masses and density do not for the crime scene hot dog do not match any of the others. The conductivity matches the fat free. The first reactivity test matched the fat free, while the second test matched the pork.

When measuring the volume of the wrap, it was hard to get an accurate measurement because the graduated cylinders that were used only measure in tenths of a milliliter and the wraps’ volumes were all approximately .1 ml. The mass of the wraps was hard to find since the balances only measured tenths of a gram and all of the substances’ masses were less than .5g. Also, there was only one conductivity meter, so it took longer for everyone to measure the conductivity. When the group squeezed the hot dogs, each person did a different one, and each person squeezed a different amount so the amount of mass post squeeze changed not only based on the different types of hot dog, but also on who squeezed it. A better way to do this would be to have the same person squeeze each one. In the real world, forensics chemists do things similar to this. They take evidence from a crime scene and test it for different properties.

Reference

<http://portal.acs.org/portal/acs/corg/content?_nfpb=true&_pageLabel=PP_ARTICLEMAIN&node_id=1188&content_id=CTP_003390&use_sec=true&sec_url_var=region1&__uuid=4915a921-ae47-4bd4-ad80-75b50e4180d9>